DECEMBER 2017 / ENDSEM

F. Y. B. TECH. (COMMON) (SEMESTER - I)

COURSE NAME: Basic Electronics Engineering

(2017 PATTERN)

Model Answers

Time: [**2 Hours**] [Max. Marks: **50**]

Q.1 a) State and prove Demorgan's theorems, Draw the logical diagrams. **[6]**

One of DeMorgan's theorems is stated as follows:

The complement of a product of variables is equal to the sum of the complements of the variables.

Stated another way,

The complement of two or more ANDed variables is equivalent to the OR of the complements of the individual variables.

The formula for expressing this theorem for two variables is

$$\overline{XY} = \overline{X} + \overline{Y}$$

DeMorgan's second theorem is stated as follows:

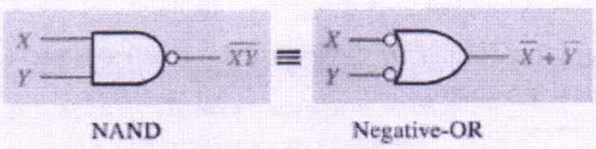
The complement of a sum of variables is equal to the product of the complements of the variables.

Stated another way,

The complement of two or more ORed variables is equivalent to the AND of the complements of the individual variables.

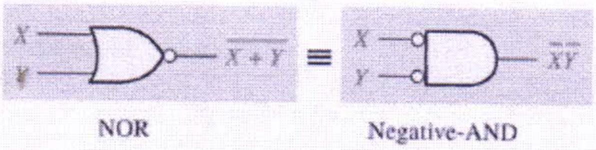
The formula for expressing this theorem for two variables is

$$\overline{X + Y} = \overline{X}\,\overline{Y}$$



NAND Negative-OR

Inputs		Output	
X	Y	$\overline{XY}$	$\overline{X}+\overline{Y}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

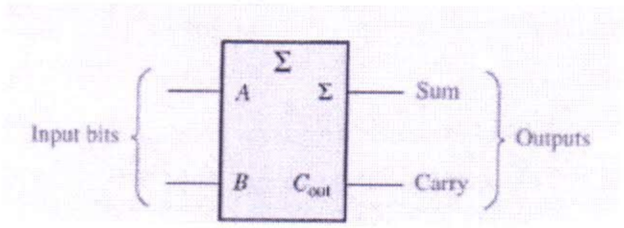


Inputs		Output	
X	Y	$\overline{X+Y}$	$\overline{X}\,\overline{Y}$
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

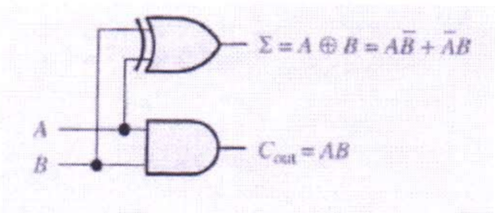
b) Design half adder with the help of suitable logic gates. **[6]**

Truth Table:

INPUTS		OUTPUTS	
A	**B**	**SUM**	**CARRY**
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1



Design from truth-table will give following simplified equations for sum and carry.



c) Prove the following [4]

i) (A+B)(A+C) = A+BC

$$\begin{aligned}(A+B)(A+C) &= AA + AC + AB + BC \\ &= A + AC + AB + BC \\ &= A(1+C) + AB + BC \\ &= A \cdot 1 + AB + BC \\ &= A(1+B) + BC \\ &= A \cdot 1 + BC \\ &= A + BC\end{aligned}$$

ii) $\overline{A\overline{B} + \overline{C}D + EF} = (\overline{A} + B)(C + \overline{D})(\overline{E} + \overline{F})$

Let $A\overline{B} = X$, $\overline{C}D = Y$, and $EF = Z$. The expression $\overline{A\overline{B} + \overline{C}D + EF}$ is of the form $\overline{X + Y + Z} = \overline{X}\,\overline{Y}\,\overline{Z}$ and can be rewritten as

$$\overline{A\overline{B} + \overline{C}D + EF} = (\overline{A\overline{B}})(\overline{\overline{C}D})(\overline{EF})$$

Next, apply DeMorgan's theorem to each of the terms $\overline{A\overline{B}}$, $\overline{\overline{C}D}$, and $\overline{EF}$.

$$(\overline{A\overline{B}})(\overline{\overline{C}D})(\overline{EF}) = (\overline{A} + B)(C + \overline{D})(\overline{E} + \overline{F})$$

OR

Q.2 a) Convert binary number 110110.1011 to decimal number and convert decimal number 82.625 to binary number. **[6]**

1) $(110110)_2 = (54)_{10}$

Step by step solution

Step 1: Write down the binary number:

110110

Step 2: Multiply each digit of the binary number by the corresponding power of two:

$1\times2^5 + 1\times2^4 + 0\times2^3 + 1\times2^2 + 1\times2^1 + 0\times2^0$

Step 3: Solve the powers:

1x32 + 1x16 + 0x8 + 1x4 + 1x2 + 0x1 = 32 + 16 + 0 + 4 + 2 + 0

Step 4: Add up the numbers written above:

32 + 16 + 0 + 4 + 2 + 0 = 54. This is the decimal equivalent of the binary number 110110.

Convert the fractional binary number 0.1011 to decimal.

Determine the weight of each bit that is a 1, and then sum the weights to get the decimal fraction.

Weight:	2^{-1}	2^{-2}	2^{-3}	2^{-4}
Binary number:	0 . 1	0	1	1

$$0.1011 = 2^{-1} + 2^{-3} + 2^{-4}$$
$$= 0.5 + 0.125 + 0.0625 = \mathbf{0.6875}$$

Therefore 110110.1011 in decimal is 54.6875

2) 82.625

$82 = 64 + 16 + 2 = 2^6 + 2^4 + 2^1 \longrightarrow$ **1010010**

Sum-of-Weights The sum-of-weights method can be applied to fractional decimal numbers, as shown in the following example:

$$0.625 = 0.5 + 0.125 = 2^{-1} + 2^{-3} = 0.101$$

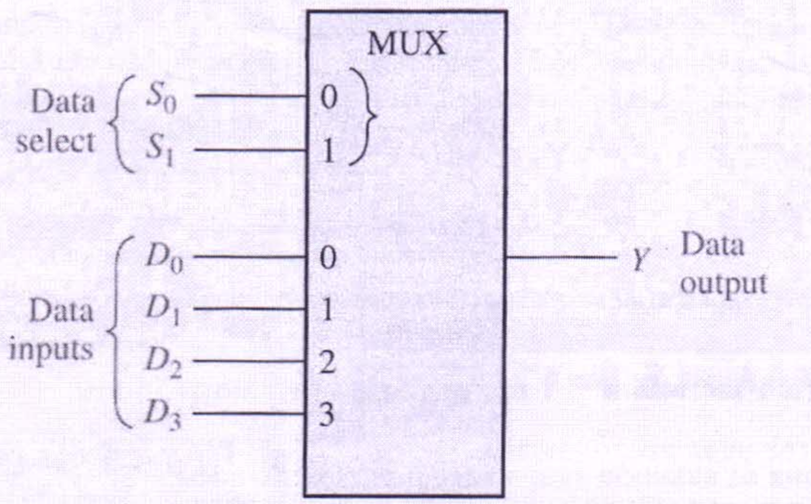
There is a 1 in the 2^{-1} position, a 0 in the 2^{-2} position, and a 1 in the 2^{-3} position.

Therefore 82.625 in binary is 1010010.101

b) Explain the working of 4:1 MUX and 1:4 De-MUX with block diagram and truth table. **[6]**

A **multiplexer (MUX)** is a device that allows digital information from several sources to be routed onto a single line for transmission over that line to a common destination. The basic multiplexer has several data-input lines and a single output line. It also has data-select inputs, which permit digital data on any one of the inputs to be switched to the output line. Multiplexers are also known as data selectors.

Block diagram of 4:1 MUX



DATA-SELECT INPUTS		
S_1	S_0	INPUT SELECTED
0	0	D_0
0	1	D_1
1	0	D_2
1	1	D_3

The data output is equal to D_0 only if $S_1 = 0$ and $S_0 = 0$: $Y = D_0\overline{S}_1\overline{S}_0$.

The data output is equal to D_1 only if $S_1 = 0$ and $S_0 = 1$: $Y = D_1\overline{S}_1S_0$.

The data output is equal to D_2 only if $S_1 = 1$ and $S_0 = 0$: $Y = D_2S_1\overline{S}_0$.

The data output is equal to D_3 only if $S_1 = 1$ and $S_0 = 1$: $Y = D_3S_1S_0$.

When these terms are ORed, the total expression for the data output is

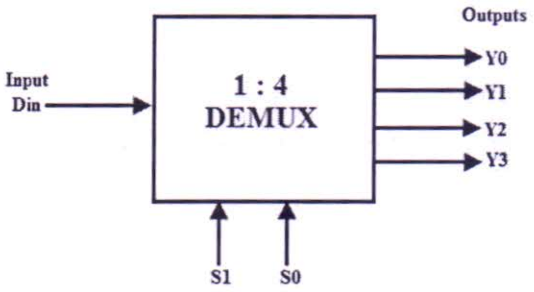
$$Y = D_0\overline{S}_1\overline{S}_0 + D_1\overline{S}_1S_0 + D_2S_1\overline{S}_0 + D_3S_1S_0$$

Demultiplexer:

The action or operation of a demultiplexer is opposite to that of the multiplexer. As inverse to the MUX , demux is a one-to-many circuit. With the use of a demultiplexer the binary data can be bypassed to one of its many output data lines. Demultiplexers are mainly used in Boolean function generators and decoder circuits. Different input/output configuration demultiplexers are available in the form of single integrated circuits (ICs).

1-to-4 Demultiplexer

A 1-to-4 demultiplexer has a single input (D), two selection lines (S1 and S0) and four outputs (Y0 to Y3). The input data goes to any one of the four outputs at a given time for a particular combination of select lines. This demultiplexer is also called as a 2-to-4 demultiplexer which means that two select lines and 4 output lines. The block diagram of 1:4 DEMUX is shown below.



Data Input	Select Inputs		Outputs			
D	S_1	S_0	Y_3	Y_2	Y_1	Y_0
D	0	0	0	0	0	D
D	0	1	0	0	D	0
D	1	0	0	D	0	0
D	1	1	D	0	0	0

From the table, the output logic can be expressed as min terms and are given below.

$Y0 = \overline{S1}\ \overline{S0}\ D$

$Y1 = \overline{S1}\ S0\ D$

$Y2 = S1\ \overline{S0}\ D$

$Y3 = S1\ S0\ D$

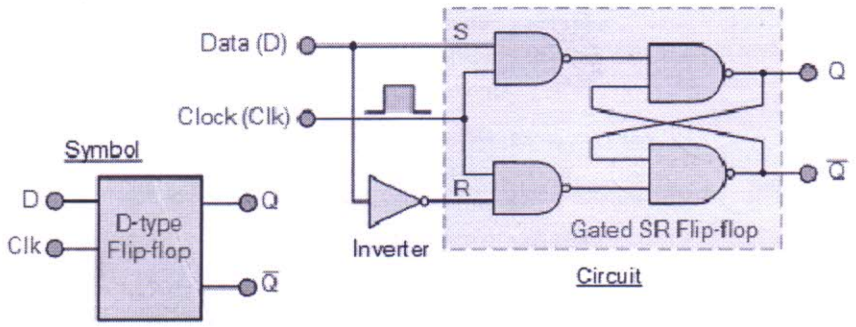
Where D is the input data, Y0 to Y3 are output lines and S0 & S1 are select lines.

c) Explain D flip flop with truth table. **[4]**

The **D Flip Flop** is by far the most important of the clocked flip-flops as it ensures that ensures that inputs S and R are never equal to one at the same time. The D-type flip flop are constructed from a gated SR flip-flop with an inverter added between the S and the R inputs to allow for a single D (data) input.

Then this single data input, labelled D, is used in place of the "set" signal, and the inverter is used to generate the complementary "reset" input thereby making a level-sensitive D-type flip-flop from a level-sensitive RS-latch as now S = D and R = not D as shown.

D-type Flip-Flop Circuit



Truth Table for the D-type Flip Flop

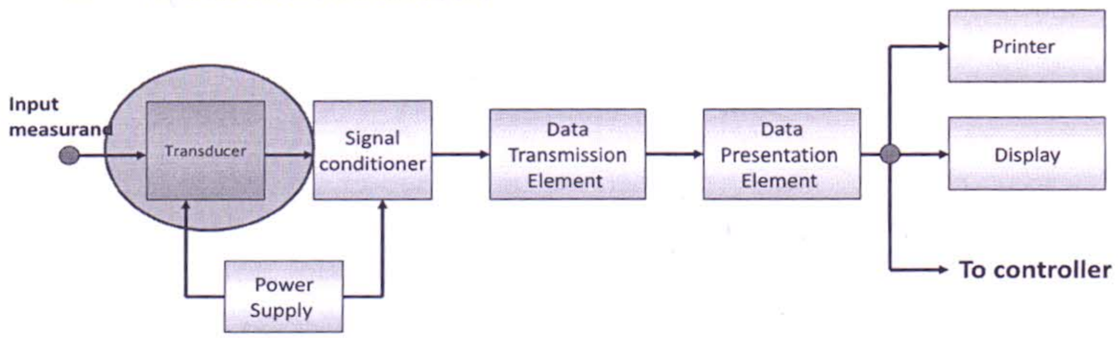
Clk	D	Q	Q	Description
↓ » 0	X	Q	Q'	Memory no change
↑ » 1	0	0	1	Reset Q » 0
↑ » 1	1	1	0	Set Q » 1

Q.3 a) Draw and explain the block diagram of basic instrumentation system. **[6]**

Basic instrumentation system

- The block diagram of generalized instrumentation system consist of :

1. A transducer
2. A signal conditioner
3. Data transmission and data presentation element.
4. The display or read out devices
5. An electrical power supply.



Block diagram of an instrumentation system

Transducer

All the physical input parameters like temperature, pressure, displacement, velocity, acceleration and so on will be converted into its proportionate electrical signal.

Signal Conditioning Unit

The output of the **transducer** is provided to the input of the signal conditioner unit. This unit amplifies the weak transducer output and is filtered and modified to a form that is acceptable by the output unit. Thus this unit may have devices like: amplifiers, filters, analog to digital converters, and so on. It includes all the balancing circuits ad calibrating elements along with it.

Data Transmission Element - The transmission of data from one another is done by the data transmission element. In case of spacecraft, the control signals are sent from the control stations by using radio signals.

The stage that follows the signal conditioning element and data transmission element collectively is called the intermediate stage.

Data Presentation Element - The display or readout devices which display the required information about the measurement, forms the data presentation element. Here the information of the measured has to be conveyed for, monitoring, control or analysis purposes. In case of data to be monitored, visual display devices are needed like ammeters and voltmeters. In case of data to be recorded, recorders like magnetic tapes, T.V equipment, and storage type CRT, printers, and so on are used.

b) Compare active and passive transducer. **[4]**

Comparison of active and Passive transducer

Sr. No.	Active transducers	Passive transducers
1	They do not require any external source or power for their operation	They require an external source of power for their operation.
2	They are self generating type transducers.	They are not self generating type transducers.
3	They produce electrical parameter such as voltage or current proportional to the physical parameter under measurement.	They produce change in the electrical parameter such as inductance, resistance or capacitance in response to the physical parameter under measurement.
4	Examples : thermocouple, photocell, piezoelectric transducers.	Examples : Thermister, LDR, LVDT, Phototransistor.

c) Explanation four characteristics of transducer. **[4]**

Any four from following:

Characteristics of a transducer

- Linearity: Linearity of any transducer is the prime requirement. A transducer having linear input output characteristics is a big plus.
- Repeatability: A transducer having this quality produces the same result again and again when the same input signal is applied repeatedly under same environmental conditions ex. Temperature, pressure, humidity etc
- Ruggedness : It is the ability of a transducer to withstand overloads. A good transducer must have a high degree of ruggedness.

- Accuracy: It is defined as closeness of the actual output obtained from transducer to the true/ideal value of the quantity to be measured. Accuracy should be high as possible.
- High Stability and Reliability: There should be minimum amount of error in measurement and output should not be affected by temperature, vibrations, environmental variations etc.
- Speed of Response: It shows how quickly the output of the transducer changes when there is change in input.
- Sensitivity: It is the smallest physical quantity that transducer can measure. Sensitivity of a transducer should be high enough so that it can measure the smallest input applied.
- Operating Range: transducer should be able to function within the specified range with good accuracy.
- Size: The size of a transducer should be very small so that it can be placed at any location for measurements.

OR

Q.4 a) What is RTD? Explain its construction and working principle. Draw the circuit diagram for measurement of temperature using RTD. **[6]**

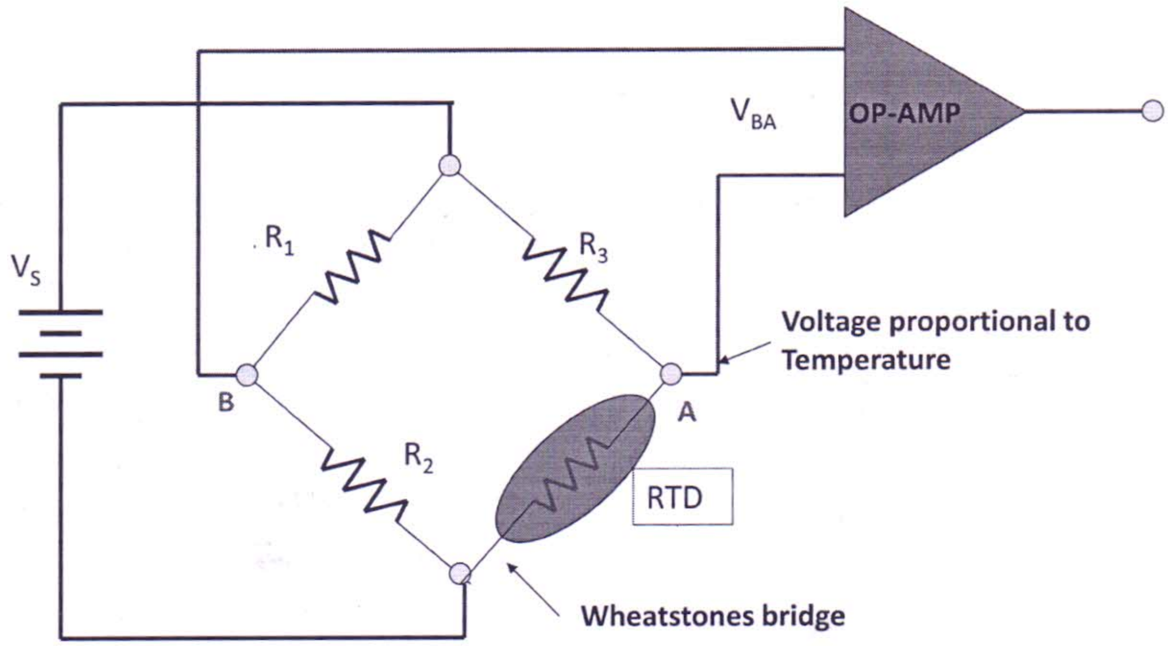
A **Resistance Thermometer** or **Resistance Temperature Detector** is a device which used to determine the temperature by measuring the resistance of pure electrical wire. This wire is referred to as a temperature sensor. It has good linear characteristics over a wide range of temperature. The variation of resistance of the metal with the variation of the temperature is given as,

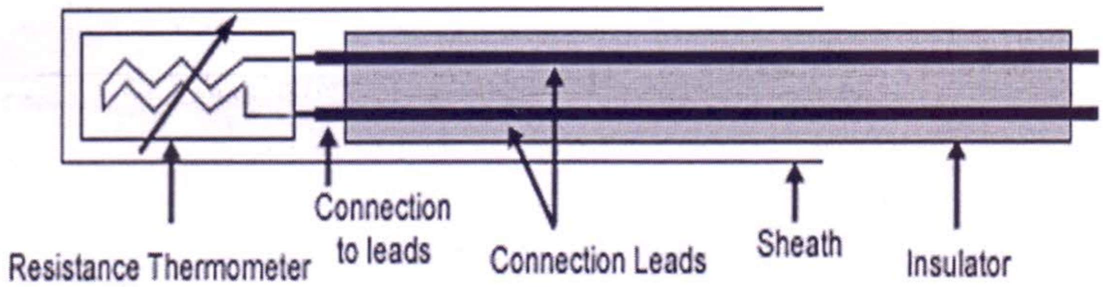
$$R_t = R_0[1 + (t - t_0) + \beta(t - t_0)^2 + \cdots\cdots]$$

Where, R_t and R_0 are the resistance values at t°C and t_0°C temperatures. α and β are the constants depends on the metals.

The construction is typically such that the wire is wound on a form (in a coil) on notched mica cross frame to achieve small size, improving the thermal conductivity to decrease the response time and a high rate of heat transfer is obtained. In the industrial RTD's, the coil is protected by a stainless steel sheath or a protective tube. Mica is placed in between the steel sheath and resistance wire for better electrical insulation. Due less strain in resistance wire, it should be carefully wound over mica sheet.

RTD resistance measurement





b) What is primary and secondary transducer? State two examples of each. **[4]**

- Some transducers contain the mechanical as well as electrical devices. The mechanical device converts the physical quantity to be measured into a mechanical signal. Such mechanical devices are called as the primary transducers.
  Ex: diaphragm, Bellows etc.

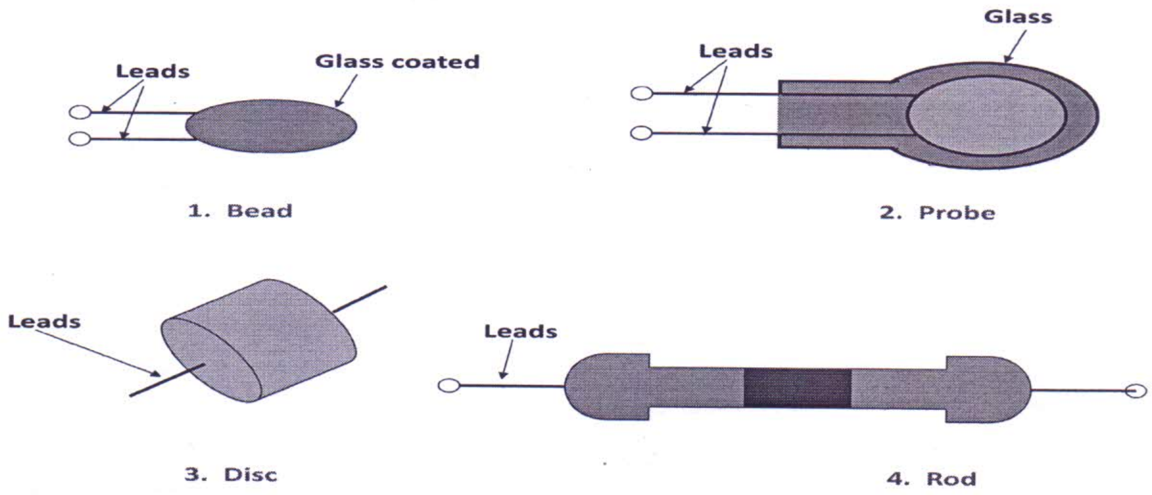
- The electrical device then converts this mechanical signal into a corresponding electrical signal. Such electrical devices are known as the secondary transducers.
  Ex: LVDT, strain gauge etc.

c) Draw the construction diagram of thermistor and explain the working principle of it. [4]

Thermistors

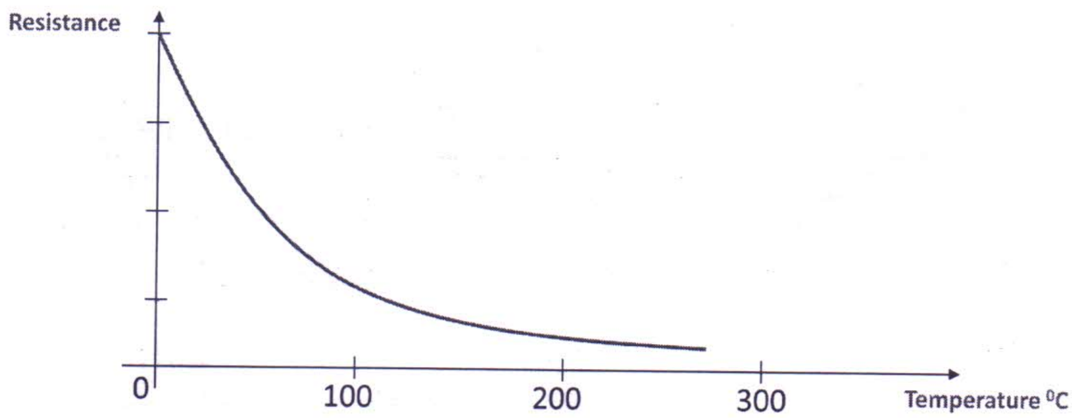
Thermistors are constructed by using the materials such as sintered mixtures of sulphides, selenides oxides of manganese, nickel, cobalt, iron, copper etc.

Construction of Thermistors



Thermistors

- Thermistors are also temperature dependent resistors (RTD). They are made of semiconductor materials which have a negative temperature coefficient of resistivity.
- The variation of resistance with changes I temperature is nonlinear.
- Thermistors can be used to measure temperatures in the range of -100^{0}C to 300^{0}C.



Q.5)Attempt following multiple choice questions:[1x20=20 marks]

1.	Peak inverse voltage for a diode is the a) voltage corresponding to rated maximum voltage b) maximum voltage that can be applied across the diode in the conducting direction c) maximum voltage that can be applied across the diode in the non-conducting direction d) none of the above. Ans: **c**	[1]
2.	The output frequency of a full-wave rectifier is ________ the input frequency. a) one-half b) equal to c) twice d) one-quarter Ans: **c**	[1]
3.	In photodiode ------------ current is proportional to light incident.. a) forward current b) reverse current c) reverse leakage current d) dark current. Ans: **c**	[1]
4.	Which diode(s) has (have) a zero level current and voltage drop in the ideal model? a) Si b) Ge c) Neither Si nor Ge d) Both Si and Ge Ans:**d**	[1]
5.	In LED light is emitted because a)Diode gets heated up b) Light falling on gets amplified c)Light gets reflected due to lens action d) Recombination of charge carriers take place Ans: **d**	[1]

6.	A transistor has a β_{dc} of 250 and a base current, I_B of 20 mA. The collector current, I_c equals: (a) 500 mA b) 5 A c) 50 mA d) 5 mA Ans: **d**	[1]
7.	The phase difference between the input and output ac voltage signals of a common-emitter amplifier is _________. a) 0° b) 180° c) 80° d) 360° Ans: **b**	[1]
8.	V_{CE} approximately equals ________ when a transistor switch is cut off. a) V_B b) V_{CC} c) 0.2 V d) 0.7 V Ans: **b**	[1]
9.	In which region are both the collector-base and base-emitter junctions Revese-biased? a. Active b. Cutoff c. Saturation d. All of the above Ans: **b**	[1]
10.	When transistors are used in digital circuits they usually operate in the: a) active region b) breakdown region c) saturation and cutoff regions d) linear region Ans: **c**	[1]
11.	A BJT is a _____-controlled device. The MOSFET is a _____ -controlled device. a. voltage, voltage b. voltage, current c. current, voltage d. current, current Ans: **c**	[1]
12.	Which of the following devices does not have a cathode terminal?	[1]

	a. SCR b. PN Junction Diode c. Triac d. Zener diode Ans: **c**	
13.	Which of the following transistors can an SCR be represented as? a. *npn, pnp* b. *npn, npn* c. *pnp, pnp* d. None of the above Ans: **a**	[1]
14.	In the forward-blocking region, the SCR is (a) in the *off* state (b) reverse-biased (c) in the *on* state (d) at the point of breakdown Ans: **a**	[1]
15.	In an E-MOSFET, there is no drain current until V_{GS} (a) reaches $V_{GS(th)}$ (b) is positive (c) is negative (d) equals 0 V Ans:**a**	[1]
16.	How many terminals do the 78XX series fixed positive voltage regulators have? a) 2 b) 3 c) 4 d) 5 Ans: **b**	[1]
17.	The 7912 regulator IC provides _____ . a. 5 V b.–12 V c. 12 V d. –5 V Ans: **b**	[1]

18.	With zero volts on both inputs, an op-amp ideally should have an output equal to (a) the positive supply voltage (b) zero (c) the negative supply voltage (d) the CMRR Ans: **b**	[1]
19.	For an op-amp with negative feedback, the output is (a) equal to the input (b) increased (c) fed back to the non-inverting input (d) fed back to the inverting input Ans: **d**	[1]
20.	A voltage-follower (a) has a gain of 1 (b) is non-inverting (c) has no feedback resistor (d) has all of these Ans: **d**	[1]